

WHAT IS CLAIMED IS:

1. An apparatus, comprising a multiplexing unit which includes:

5 an optical input terminal to which can be applied an optical input signal that includes a plurality of optical component signals which are different;

 an optical output terminal at which said multiplexing unit produces an optical output signal;

10 a plurality of protection input terminals;

 a plurality of protection output terminals;

 a further terminal;

 a demultiplexer having an input coupled to said optical input terminal, and having a plurality of outputs, said demultiplexer being operable to optically isolate the component signals of the input signal, and to optically supply each of the isolated component signals to a respective one of said outputs thereof;

 a plurality of switching units each having first and second inputs and first and second outputs, each said switching unit being capable of optically coupling said first output thereof to a selected one of said first and second inputs thereof, and being capable of optically coupling said second output thereof to a selected one of said first and second inputs thereof, wherein said outputs of said demultiplexer are each coupled to said first input of a respective said switching unit, said protection input terminals are each coupled to said second input of a respective said switching unit, and said protection output terminals are each coupled to said second output of a respective said switching unit;

 a multiplexer having an output coupled to said optical input terminal, and having a plurality of inputs which are each coupled to said first output of a respective said

switching unit, said multiplexer being operable to optically multiplex onto said output respective optical component signals present at each of said inputs thereof; and .

5 a portion operable to facilitate one of: causing one of the component signals from the input signal to be routed to said further terminal, and causing a component signal present at said further terminal to be included in the optical output signal.

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2. An apparatus according to Claim 1, wherein each said switching unit includes a first optical switch having first and second inputs respectively coupled to said first and second inputs of the switching unit, and having first and second outputs respectively coupled to said first and outputs of the switching unit.

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3. An apparatus according to Claim 1, wherein each said switching unit includes a third output, and is capable of optically coupling said third output to a selected one of said first and second inputs.

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4. An apparatus according to Claim 3, wherein said multiplexing unit includes a plurality of drop terminals, one of which is said further terminal; and wherein said portion of said multiplexing unit couples each said drop terminal to said third output of a respective said switching unit.

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5. An apparatus according to Claim 3, wherein each said switching unit includes:

5 a first optical switch having first and second inputs respectively coupled to said first and second inputs of the switching unit, having a first output coupled to said first output of the switching unit, and having a second output; and

10 a second optical switch having an input coupled to said second output of said first optical switch, and having first and second outputs which are respectively coupled to said second and third outputs of the switching unit.

6. An apparatus according to Claim 1,

15 wherein each said switching unit includes a third input, is capable of optically coupling said first output thereof to a selected one of said first, second and third inputs thereof, and is capable of optically coupling said second output thereof to a selected one of said first, second and third inputs thereof;

20 wherein said multiplexing unit includes a plurality of add terminals, one of which is said further terminal; and

wherein said portion of said multiplexing unit couples each said add terminal to said third input of a respective said switching unit.

7. An apparatus according to Claim 6, wherein each said switching unit includes:

5 a first optical switch having first and second inputs respectively coupled to said second and third inputs of the switching unit, and having an output; and

10 a second optical switch having first and second inputs respectively coupled to said first input of the switching unit and said output of said first optical switch, and having first and second outputs respectively coupled to said first and second outputs of the switching unit.

8. An apparatus according to Claim 6,

15 wherein said multiplexing unit includes a plurality of regenerators which are each coupled between a respective output of said demultiplexer and said first input of a respective said switching unit; and

20 wherein said portion of said multiplexing unit includes a plurality of transponders which are each coupled between a respective said add terminal and said third input of a respective said switching unit.

9. An apparatus according to Claim 1,

wherein each said switching unit includes a third input and a third output, is capable of optically coupling said first output thereof to a selected one of said first, second and third inputs thereof, is capable of optically coupling said second output thereof to a selected one of said first, second and third inputs thereof, and is capable of optically coupling said third output thereof to a selected one of said first, second and third inputs thereof;

wherein said multiplexing unit includes a plurality of add terminals, one of which is said further terminal; and

wherein said portion of said multiplexing unit couples each said add terminal to said third input of a respective said switching unit.

10. An apparatus according to Claim 9, wherein said multiplexing unit includes a plurality of drop terminals; and wherein said portion of said multiplexing unit couples each said drop terminal to said third output of a respective said switching unit.

11. An apparatus according to Claim 9, wherein each said switching unit includes:

5 a first optical switch having first and second inputs respectively coupled to said second and third inputs of the switching unit, and having an output;

10 a second optical switch having first and second inputs respectively coupled to said first input of the switching unit and said output of said first optical switch, having a first output coupled to said first output of the switching unit, and which has a second output; and

15 a third optical switch having an input coupled to said second output of said second optical switch, and having first and second outputs respectively coupled to said second and third outputs of the switching unit.

12. An apparatus according to Claim 1,
wherein said further terminal functions as a drop terminal;

20 wherein said portion of said multiplexing unit includes an optical coupling section which is coupled between said optical input terminal and said input of said demultiplexer, and includes an optical filter which is coupled between said coupling section and said drop terminal;

25 wherein said coupling section supplies said optical input signal to each of said demultiplexer and said optical filter; and

30 wherein said optical filter extracts from said input signal and supplies to said drop terminal a respective one of said component signals of said input signal.

13. An apparatus according to Claim 12,
wherein said multiplexing unit includes an add
terminal;

5 wherein said portion of said multiplexing unit
includes a further optical coupling section which is
coupled between said output of said multiplexer, said add
terminal and said optical input terminal; and

10 wherein said further optical coupling section is
operable to optically combine optical signals from said
output of said multiplexer and said add terminal in order
to obtain said optical output signal for said optical input
terminal.

14. An apparatus according to Claim 1,
15 wherein said further terminal functions as an add
terminal;

20 wherein said portion of said multiplexing unit
includes an optical coupling section which is coupled
between said output of said multiplexer, said add terminal
and said optical input terminal; and

25 wherein said optical coupling section is operable to
optically combine optical signals from said output of said
multiplexer and said add terminal in order to obtain said
optical output signal for said optical input terminal.

15. An apparatus according to Claim 1,
wherein said multiplexing unit includes a plurality of
regenerators which are each coupled between a respective
output of said demultiplexer and said first input of a
30 respective said switching unit; and

wherein said portion of said multiplexer unit includes
a transponder which couples said further terminal to said
portion of said multiplexing unit.

16. An apparatus, comprising first and second multiplexing units which each include:

an optical input terminal to which can be applied a respective optical input signal that includes a plurality
5 of optical component signals which are different;

an optical output terminal at which said multiplexing unit produces an optical output signal;

a plurality of protection input terminals;

a plurality of protection output terminals;

10 a further terminal;

a demultiplexer having an input coupled to said optical input terminal, and having a plurality of outputs, said demultiplexer being operable to optically isolate the component signals of the input signal, and to optically
15 supply each of the isolated component signals to a respective one of said outputs thereof;

a plurality of switching units each having first and second inputs and first and second outputs, each said switching unit being capable of optically coupling said
20 first output thereof to a selected one of said first and second inputs thereof, and being capable of optically coupling said second output thereof to a selected one of said first and second inputs thereof, wherein said outputs of said demultiplexer are each coupled to said first input
25 of a respective said switching unit, said protection input terminals are each coupled to said second input of a respective said switching unit, and said protection output terminals are each coupled to said second output of a respective said switching unit;

30 a multiplexer having an output coupled to said optical input terminal, and having a plurality of inputs which are each coupled to said first output of a respective said switching unit, said multiplexer being operable to optically multiplex onto said output respective optical

component signals present at each of said inputs thereof;
and

5 a portion operable to facilitate one of: causing one
of the component signals from the input signal to be routed
to said further terminal, and causing a component signal
present at said further terminal to be included in the
optical output signal;

10 wherein said protection output terminals of said first
multiplexing unit are each coupled to a respective said
protection input terminal of said second multiplexing unit,
and said protection output terminals of said second
multiplexing unit are each coupled to a respective said
protection input terminal of said first multiplexing unit.

15 17. An apparatus according to Claim 16,

20 wherein each said switching unit in each said
multiplexing unit includes a third input and a third
output, is capable of optically coupling said first output
thereof to a selected one of said first, second and third
inputs thereof, is capable of optically coupling said
second output thereof to a selected one of said first,
second and third inputs thereof, and is capable of
optically coupling said third output thereof to a selected
one of said first, second and third inputs thereof;

25 wherein said each multiplexing unit includes a
plurality of add terminals, one of which is said further
terminal; and

30 wherein said portion of each said multiplexing unit
couples each said add terminal of that multiplexing unit to
said third input of a respective said switching unit of
that multiplexing unit.

18. An apparatus according to Claim 17, wherein each
said multiplexing unit includes a plurality of drop
terminals; and wherein said portion of each said
multiplexing unit couples each said drop terminal of that
5 multiplexing unit to said third output of a respective said
switching unit of that multiplexing unit.

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19. A method of multiplexing optical signals in a multiplexing unit which includes an optical input terminal, an optical input terminal, a plurality of protection input terminals, a plurality of protection output terminals, a further terminal, and a plurality of switching units that each have first and second inputs and first and second outputs, comprising the steps of:

receiving at the optical input terminal an optical input signal which includes a plurality of optical component signals that are different;

optically demultiplexing the input signal to isolate respective component signals thereof;

supplying each of the isolated component signals to the first input of a respective one of the switching units;

operatively coupling each of the protection input terminals to the second input of a respective one of the switching units;

operatively coupling each of the protection output terminals to the second output of a respective one of the switching units;

causing each of the switching units to optically couple at least one of the outputs thereof to a selected one of the inputs thereof;

optically multiplexing the optical signals from the second outputs of the switching units to produce a multiplexed signal;

supplying to said optical output terminal an optical output signal which is based on said multiplexed signal; and

carrying out one of the steps of: causing one of the component signals from the optical input signal to be routed to said further terminal, and causing a component signal present at said further terminal to be included in the optical output signal.

20. A method according to Claim 19,

5 wherein each of the switching units includes a third input and a third output, and the multiplexing unit includes a plurality of add terminals which are each coupled to the third input of a respective one of the switching units, the further terminal being one of the add terminals ; and

10 wherein said causing step is carried out by causing each of the switching units to optically couple at least one of the first, second and third outputs thereof to a selected one of the first, second and third inputs thereof.

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